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ABSTRACT

Review of reversal learning data obtained from Ss of various developmental phases suggested that overtraining increases perseveration in pre-school children, and decrease perseveration in older (e.g., 1st grade) children. The present experiment tested this apparent trend. Children of two age groups (X = 4 yrs., 4 mos., vs. X = 6 yrs., 5 mos.) learned a reversal shift after having been trained to a 9 of 10 criterion, or after 20 or 40 additional overtraining trials. The results indicated that overtraining has no effect upon perseveration in the younger children, and increased perseveration in the older children, failing to confirm the apparent development trend. It was also found that criterion-trained younger Ss perseverated more than did criterion-trained older Ss, but that this age difference disappeared in the overtraining conditions. Finally, it was found that ease of overall reversal learning was unaffected by the amount of original training in both age groups. (Author)

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Final Report

Project No. 1-C-049
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AMOUNT OF TRAINING, AGE OF SUBJECT, AND PERSEVERATION IN REVERSAL LEARNING

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It was also found that criterion-trained younger Ss perseverated more than did criterion-trained older Ss, but that this age difference disappeared in the overtraining conditions.

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INTRODUCTION

In discrimination learning tasks, the S is presented with stimuli which vary along one or more dimensions (*e.g.*, color), each dimension being represented by two or more specific cues (*e.g.*, red, blue). The S is differentially reinforced for responses to cues along the relevant dimension (*e.g.*, responses to red are reinforced and those to blue are not). In a reversal shift (RS) task, the correct choice responses are the opposite of those correct during original training (*e.g.*, responses to blue are reinforced and those to red are not). Perseveration in RS learning refers to continuing to make the originally correct choice responses during RS training. The present project was concerned with the effects of amount of original training and the age of the S upon perseverative behavior in RS learning. The present project was concerned with choice response data, rather than response latency data, which have been discussed by Sperling (1965).

In several studies using rats as Ss and a two choice visual paradigm, the tendency to perseverate was positively related to the amount of original training (*e.g.*, Eimas, 1967; Mackintosh, 1962; 1965a; O'Malley and Bruning, 1969; Reid, 1953). In most of these studies perseveration was measured in terms of the number of consecutive originally correct responses before the first change from those responses during RS training. Relatively few experiments have investigated RS learning in very young (*i.e.*, nursery school) children, and perseveration data are reported in only one (Gollin, 1964). In this study overtraining on a two-choice conditional discrimination (10 or 20 trials beyond a criterion of 10 consecutive correct responses) resulted in more perseveration in the first 10 trials of RS learning than did criterion training. The Ss were 3½ to 4½ yrs. of age. Thus, as with rats, overtraining increased perseveration with very young children as Ss. Perseveration data have been reported in a few RS experiments using Ss around kindergarten age. In Gollin's experiment overtraining did not significantly affect perseveration by Ss aged 4½ to 5 yrs. Stevenson and Weir (1959), employing a three-choice position paradigm, found that overtraining did not significantly affect perseveration by Ss aged 5 to 6 yrs. Stevenson and Zeigler (1957) used children whose mean age was 5.3 yrs. Overtraining on a three-choice size discrimination (30 trials beyond a criterion of five consecutive correct responses) did not affect the number of perseverative errors made by Ss in the first 30 RS trials. Youniss and

Furth (1964) used children aged 7 to 9 yrs., and a three-choice size discrimination. Overtraining consisted of 18 trials beyond a criterion of six consecutive correct responses. An analysis was computed based upon the number of perseverative errors made in the first and second three-trial blocks of RS training. Overtrained Ss made more perseverative errors in the first block, but significantly fewer in the second block; in addition, the decrease in perseverative errors from the first to the second block was significant only for the overtrained Ss. The authors were apparently more impressed by the significant reduction in perseveration after the first block by the overtrained Ss, since they explained their results in terms of the discrimination hypothesis of extinction (Capaldi and Stevenson, 1957). According to the discrimination hypothesis, overtraining should reduce perseveration in RS learning by making the change in the reinforcement contingency more noticeable for the overtrained Ss. In subsequent experiments with Ss aged 6 to 8 yrs. (Furth & Youniss, 1964; Youniss & Furth, 1965) similar results were obtained. Ludvigson and Caul (1964), using both a two-choice and a four-choice visual discrimination, found that overtraining significantly reduced perseveration in RS training. Perseveration was measured in terms of the number of consecutive originally correct responses before the first change from that response. In similar studies the same results have been obtained (Caul & Ludvigson, 1964; Ludvigson, 1966).

A trend is thus evident in the perseveration data. Overtraining tends to increase perseveration in RS learning when rats and very young children are used as Ss. Kindergarten seems to be a "transition" age, in that overtraining has no reliable effect upon perseveration during that age. Overtraining tends to reduce perseveration by older children and adult Ss. The results of Youniss and Furth (1964) and of Furth and Youniss, 1964, are somewhat problematic in that overtraining increased perseveration in the first block of RS training, but the more pronounced effect of decreased perseveration by overtrained Ss is consistent with the general trend. This developmental trend, while interesting in itself, also has implications for certain theories of discrimination and concept learning. For example, Kendler and Kendler (1962), based upon comparisons of the relative ease with which Ss of different developmental levels learn an RS versus an extradimensional nonreversal shift, have concluded that approximately kindergarten age is a transition age between one-stage, S-R learning and two-stage, mediational learning. Unfortunately, the experiments conducted so far have involved a variety of paradigms, and perseveration has been measured in several ways. The present study

employed the same procedures for different age groups. In addition to the perseveration data, the present project was concerned with overall RS learning, as a function of amount of original training and age of the subject. In a number of RS studies using children as Ss which have been reviewed by Wolff (1967), a variety of results has been obtained. Although overtraining was more likely to facilitate RS learning when visual cues were used as discriminanda than when position paradigms were used, several experimenters obtained nonsignificant results, and overtraining even resulted in slower RS learning in some studies. The need for further investigation is obvious.

METHOD

Subjects. The Ss were 109 children enrolled in elementary and nursery schools in the Scranton, Pennsylvania area. The particular institutions from which children were obtained were the Abington Heights School District and the Lackawanna County Day Care Program. The Ss were of two age groups: 3-5 yrs. and 5½-7½ yrs. The mean ages of the two groups were 4 yr. 4 mo. and 6 yr. 5 mo. respectively. Within each age group the number of males and females was about equal. The data of 13 children were discarded for reasons discussed below.

Apparatus and Materials. Stimuli were presented via a Hunter Model 340 Card Master. The stimuli consisted of cross-combinations of four colors (red, blue, yellow, green) and four shapes (circle, triangle, cross, square) drawn on standardized plastic cards. The experiment was conducted in suitable rooms at the schools from which Ss were obtained. Marbles and small toys were used as reinforcers.

Procedure. Forty-eight Ss at each age level learned either a color or a shape discrimination to a criterion of nine correct out of 10 responses. Upon reaching criterion, 16 Ss immediately, without warning from E, began RS training, another 16 Ss received 20 overtraining trials, and the remaining 16 Ss received 40 overtraining trials before entering RS training. Within each of the six treatment groups thus created (two age levels by three levels of original training), eight Ss learned a color discrimination and eight a shape discrimination. The task was two-choice, variable-irrelevant, in both original and RS training. The particular stimuli

assigned to an S consisted of combination of two shapes and two colors presented simultaneously, with the left-right positions of the cues balanced. For example, an S might be assigned to the following cue-combinations: red circle left, blue triangle right; red circle right, blue triangle left; blue circle left, red triangle right; blue circle right, red triangle left. Two random sequences of such a four-card set were employed for eash S. The Ss were randomly assigned to stimulus combinations. As in original training, the RS criterion was nine of 10.

The S upon being introduced to the experimental room, was told that he would see two pictures in the Window of the Cardmaster, one a winner and the other a loser, and that if the winner were chosen, the E would place a marble into a box situated near S. In addition, the S was told that marbles could be traded in for one of several toys visible to him at the end of the game. The S was instructed to choose the winning picture by simply pointing at it. The E manually controlled the presentation of stimuli, S being given unlimited time to respond.

A noncorrection procedure was employed throughout the experiment. If an S had not reached the original training criterion by 100 trials, the experiment was discontinued and his data were discarded. There were 13 such Ss (10 in the younger age group and three in the older group). If an S had not reached RS criterion by 80 trials his training was discontinued and a score of 80 trials was entered.

RESULTS

For each S, the following data were recorded: number of trials and errors to original criterion, number of initial consecutive perseverative errors in reversal training, number of perseverative errors in the first 10 trials of reversal training, and number of trials and errors to reversal criterion.

Original training. Analysis of the trials to original criterion data via the Kruskal-Wallis one-way analysis of variance revealed no differences among the six treatment groups ($H = 4.94$, $p > .40$). The errors to original criterion data revealed similar results ($H = 3.15$, $p > .50$). Table 1 presents the original training data for all treatment groups.

Perseveration data. Separate analyses of the number of initial perseverative errors were conducted for each age group. For the younger group, the amount of original training did not affect perseveration ($H = 0.37$, $p > .80$).

In the case of the older group, perseveration was significantly affected by the amount of original training ($H = 9.22$, $p < .01$). Individual comparisons using the Mann-Whitney test revealed that the C + 40 group perseverated more than did the criterion group ($Z = 3.01$, $p < .01$). The criterion group did not differ from the C + 20 group ($Z = 1.59$) nor did the C + 20 group differ from the C + 40 group ($Z = 1.46$). Comparisons of the age groups at each level of original training using the Mann-Whitney test revealed that at criterion training, the younger Ss perseverated more than the older Ss did ($Z = 2.37$, $p < .02$). There was no age difference at the C + 20 condition ($A = 1.25$, $p > .20$), nor was there a difference at the C + 40 condition ($Z = 0.13$, $p > .80$). Table 2 presents group medians.

Analyses of the number of perseverative errors in the first 10 trials of RS training (see Table 3) revealed no effect of amount of original training in the case of the young age group ($H = 0.38$, $p > .90$). A significant effect of training was obtained in the case of the older Ss ($H = 6.76$, $p < .03$). Individual comparisons using the Mann-Whitney test indicated that the C + 40 group made more perseverative errors than the criterion group ($Z = 2.45$, $p < .02$). The criterion vs. C + 20 ($Z = 1.43$, $p > .10$) and the C + 20 vs. C + 40 comparisons ($Z = 1.41$, $p > .10$) were nonsignificant. Comparisons of the age groups at each level of original training indicated that at the criterion condition younger Ss made more perseverative errors than did the older Ss ($Z = 3.13$, $p < .002$). There was no age difference at the C + 20 condition ($Z = 1.90$, $p < .06$) nor was there a difference at the C + 40 condition ($Z = 0.75$, $p > .40$).

Reversal data. Analyses of trials to RS criterion revealed that the amount of original training did not affect speed of reversal learning in the case of the younger children ($H = 3.80$, $p > .10$). The errors to reversal data yielded similar results ($H = 3.56$, $p > .10$). Similarly, ease of RS learning was not affected by amount of original training in the case of the older Ss, as indicated by the trials to criterion analysis ($H = 4.12$, $p > .10$) and the trials to criterion analysis ($H = 5.23$, $p > .05$). Comparisons of the age groups at the various levels of original training indicated that at the criterion condition younger Ss required more trials to reach criterion ($Z = 2.63$, $p < .01$). The comparisons at the C + 20 ($Z = 0.72$, $p > .40$) and the C + 40

conditions ($Z = 1.33$, $p > .10$) were nonsignificant. Similarly, the younger Ss made more errors at the criterion condition ($Z = 2.80$, $p < .005$), with no age difference being obtained at the C + 20 ($Z = 1.20$, $p > .20$) and the C + 40 ($Z = 1.32$, $p > .10$) conditions. The trials and errors to reversal medians are presented in Tables 4 and 5, respectively.

CONCLUSIONS

Perseveration data. It is obvious that the developmental trend suggested by previous perseveration data was not obtained in the present experiment. The nonsignificant effect of amount of original training in the case of the younger group might reflect a ceiling effect, with Ss in all training levels showing a very high rate of perseveration. In the case of the older Ss, overtraining clearly tended to increase perseveration, contrary to the trend in the literature. Regarding age comparisons, younger children demonstrated greater perseveration at the criterion condition, indicating their greater difficulty in relinquishing the originally correct choice responses. The generally negative effect of overtraining in the case of the older children is further indicated by the fact that in the overtraining conditions their superiority over the younger children was eliminated.

Reversal data. Analogous conclusions can be drawn from the RS data, *i.e.*, while older children were clearly superior to the younger Ss at the criterion condition, overtraining eliminated this superiority.

Little can be said concerning the nonsignificant effect of the amount of original training upon speed of overall RS learning within each age group, except that the data add to an already confusing body of literature in which overtraining has been found to have all possible effects upon RS learning (*cf.* Wolff, 1967).

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Table 1. Median Number of Trials and Errors to Original Training Criterion.

Group	Trials	Errors
Younger, C	14.50	5.00
Younger, C + 20	22.00	6.00
Younger, C + 40	16.50	3.00
Older, C	13.50	2.50
Older, C + 20	15.50	3.50
Older, C + 40	11.50	2.00

Table 2. Median Number of Consecutive Perseverative Errors in RS Training.

Age Level	Amount of Original Training	
Younger	C	14.00
Younger	C + 20	7.50
Younger	C + 40	13.50
Older	C	2.00
Older	C + 20	4.00
Older	C + 40	7.00

Table 3. Median Number of Perseverative Errors in the First Ten Trials of RS Training.

Age Level	Amount of Original Training	
Younger	C	10.00
Younger	C + 20	10.00
Younger	C + 40	10.00
Older	C	3.00
Older	C + 20	4.00
Older	C + 40	9.00

Table 4. Median Number of Trials to RS Criterion.

Age Level	Amount of Original Training	
Younger	C	28.50
Younger	C + 20	26.00
Younger	C + 40	35.00
Older	C	13.50
Older	C + 20	16.00
Older	C + 40	26.00

Table 5. Median Number of Errors to RS Criterion.

Age Level	Amount of Original Training	
Younger	C	11.00
Younger	C + 20	13.50
Younger	C + 40	24.50
Older	C	4.00
Older	C + 20	7.00
Older	C + 40	16.50